HD-TD-10GMX-6 / HD-TD-10GDX-6

A multiplexer/de-multiplexer pair for up to six HD-SDI streams plus two SD-SDI streams, transported over a 10G fiber link.

User manual

Rev. B

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Revision history

Current revision of this document is the uppermost in the table below.

Rev.	Repl.	Date	Sign	Change description
B	A	2013-12-13	TB	Revised power consumption figures and corrected pin numbering for the GPIO alarm lines.
A	-	2013-10-30	TB	Initial revision

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1 Product overview

The HD-TD-10GMX-6 / HD-TD-10GDX-6 pair of cards is a Flashlink solution for transporting up to six HD-SDI and two SD-SDI video streams over a single 10 Gb/s link.

Six ports accept all common HD-SDI/SD-SDI/ASI formats and standards, and the transport solution is completely transparent with any combination of formats and standards. The same applies to ports 7 and 8 as well, except that they are limited to video streams up to 270 Mb/s only. It is thus possible to transport up to six HD-SDI streams *plus* two SD-SDI streams simultaneously. Each of the HD-SDI input streams can however be substituted for an SD-SDI stream to transport up to eight SD-SDI streams with a single pair of cards

In combination with other Nevion Flashlink products (SD-TD-MX-4 and SD-TD-DX-4) that can pack up to four SD-SDI streams into a single HD-SDI stream, it is possible to transport up to 26 SD-SDI streams over a single 10 Gb/s link. Physically this combination will fit in a single Flashlink frame at each end of the 10 Gb/s link.

The inputs have built-in error detection and video format detection. For each of the input or output channels there is also the option to trigger a Multicon Gyda alarm if the current video format doesn’t match what the operator has indicated as normal.

The SFP+ optical transmitter and receiver module can easily be replaced. If new SFP+ modules bring significant improvements over the current ones, a quick and simple upgrade path exists.

1.1 Product variants

At present there are no sub-variants of the HD-TD-10GMX-6 / HD-TD-10GDX-6 pair.

Note that although other SFP modules will fit physically, only the Nevion branded dual SFP+ modules for the HD-TD-10GMX-6 / HD-TD-10GDX-6 will work correctly.

2 Connections

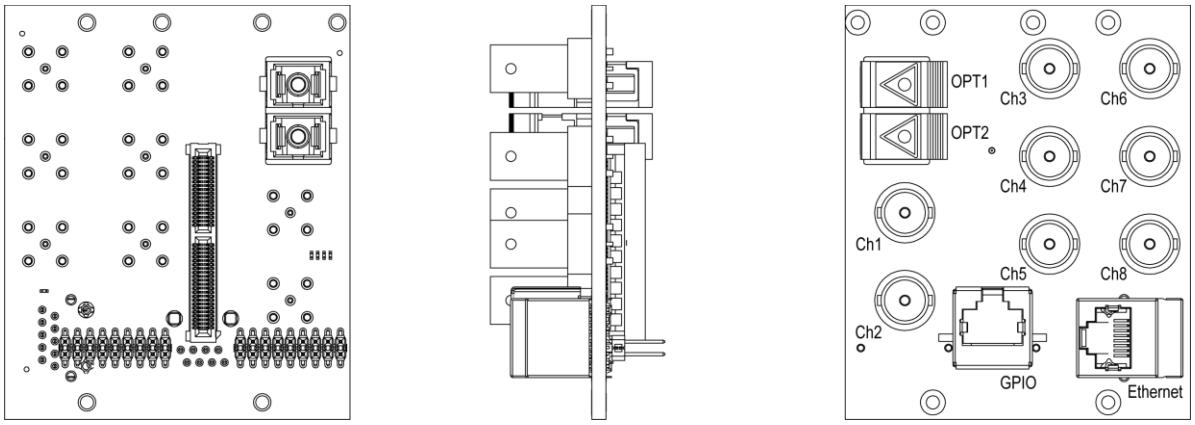


Figure 1: The backplane, HD-TD-10G-C1

The backplane HD-TD-10G-C1 is used for both the mux and the de-mux modules. All external connections are made via the backplane.

The backplane occupies two slots in the Flashlink frame, and the module will then go in the rightmost of the two slots.

Function	Label	Connector type
HD/SD-SDI channel 1	Ch1	BNC
HD/SD-SDI channel 2	Ch2	BNC
HD/SD-SDI channel 3	Ch3	BNC
HD/SD-SDI channel 4	Ch4	BNC
HD/SD-SDI channel 5	Ch5	BNC
HD/SD-SDI channel 6	Ch6	BNC
SD-SDI channel 7	Ch7	BNC
SD-SDI channel 8	Ch8	BNC
TX optical port w/cover	OPT1	---
RX optical port w/cover	OPT2	---
GPI outputs	GPIO	TP45, pin 2 (card status, open when alarm) TP45, pin 3 (channel 1-4 status, closed when alarm), TP45, pin 6 (channel 5-8 status, closed when alarm)
GPI inputs	GPIO	TP45, pin 1 (laser disable, active low)
GPI GND	GPIO	TP45, pin 8
---	Ethernet	TP45

Table 1: Connector functions

3 Configuration and control

3.1 In Multicon

The HD-TD-10GMX-6 / HD-TD-10GDX-6 pair is made to be as transparent as possible, and therefore there are only a few functions that are configurable. Basically, the modules will do as little as possible to the signals themself, but they will provide error detection and a few nifty options to raise alarms on unexpected video formats, or to diagnose errors that occur very infrequently.

As far as the user interface goes, the mux and de-mux modules are very similar. The mux has a laser and laser on/off setting, whereas the de-mux has a pin-diode receiver without any settings. Furthermore, the mux can detect more types of errors than the de-mux, but the de-mux has an extra signal integrity block for the 10G input.

In the following the mux user interface will be used to illustrate the features in question, and the text will describe any differences between the mux and the de-mux.

HD/SD mux with 10G uplink

Card label	Locate card sec
Firmware upgrade	Upload file: None Upload
Laser	On Off
Error bit behavior	Normal Sticky
Input integrity 1 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 2 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 3 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 4 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 5 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 6 (HD/SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 7 (SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Input integrity 8 (SD)	Max error rate: 10 errors/s Max error count: 250 errors Alarm hold time: 60 s
Expected video format ch 1	Don't care
Expected video format ch 2	Don't care
Expected video format ch 3	Don't care
Expected video format ch 4	Don't care
Expected video format ch 5	Don't care
Expected video format ch 6	Don't care
Expected video format ch 7	Don't care
Expected video format ch 8	Don't care

Figure 2: An overview of the mux configuration page

HD/SD demux with 10G downlink

Card label					Locate card		sec				
Firmware upgrade	Upload file: None	Upload									
Error bit behavior	Normal	Sticky									
10G input integrity	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 1 (HD/SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 2 (HD/SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 3 (HD/SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 4 (HD/SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 5 (HD/SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 6 (HD/SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 7 (SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Output integrity 8 (SD)	Max error rate: 10	errors/s	Max error count: 250	errors	Alarm hold time: 60	s					
Expected video format ch 1	Don't care										
Expected video format ch 2	Don't care										
Expected video format ch 3	Don't care										
Expected video format ch 4	Don't care										
Expected video format ch 5	Don't care										
Expected video format ch 6	Don't care										
Expected video format ch 7	Don't care										
Expected video format ch 8	Don't care										

Figure 3: An overview of the de-mux configuration page

3.1.1 Laser on/off (mux side only)

The laser on/off setting is only found on the mux side. The video transport from mux to de-mux will obviously not work when the laser is switched off, and this setting is primarily intended as a safety feature when work is being done on the rear of a live Flashlink rack. A GPIO input line is also available to disable the laser, see chapter 3.3.

3.1.2 Sticky vs. Normal error indication

When errors are detected and counted they are indicated on the Multicon Info page by red background in the corresponding error box. Default behavior (Normal error indication mode) is to accumulate error types between each time Multicon asks for status.

Due to the internal architecture of Multicon it is possible that errors will occur and the error counter increase without any error bits being shown as red on the information page. The processes that retrieve information from the cards are not synced up to the processes that display the results to multiple users/clients. What this means is that short-lived errors may turn up and disappear again *between* two web browser updates for a certain client. The error will be counted, but the operator may never see any indication of what kind of error that occurred.

For errors that occur very infrequently it is also inconvenient to sit around and wait for them to happen, but it would still be interesting to know what type of error it was.

As a solution for both these situations the mux and de-mux provides the Sticky error indication mode. In this mode the error bits will only be cleared when the operator resets the error counter from the Multicon Info page. The error counters will still only count the number of fields or frames that actually contains errors. This way it is possible to diagnose the error even a long time after the error situation has been rectified. Note however that if several errors have occurred since the last counter reset it will not be possible to tell when or for how long each was present, or if they occurred at the same time or not.

3.1.3 Signal integrity

Input integrity 2 (HD/SD)
Max error rate: 10 errors/s
Max error count: 250 errors
Alarm hold time: 60 s
Error mask APV FFV NO_EDH VS FF-CRC AP-CRC LOCK CCS YCS CCRC YCRC LNUM SAV EAV
Count:
Ignore:

Figure 4: Selection of error bits to be counted or ignored

Eight built-in analyzers – one for each input or output – will report errors seen in the previous video frame. The de-mux also has an analyzer for the 10G fiber input. The errors that can be detected in one or more of the detectors are:

NO_EDH: No EDH flags

VS: Unexpected video format (see ch 3.1.4)

FF-CRC: Full-frame checksum error

AP-CRC: Active picture checksum error

LOCK: Can't lock to incoming video standard

CCS / YCS: Checksum error in ancillary data packets, Y or C data space.

CCRC / YCRC: Line checksum error, Y or C (HD only)

LNUM: Unexpected line number sequence (HD only)

SAV: Unexpected Start-of-active-video sequence

EAV: Unexpected End-of-active-video sequence

The operator can select which of the errors are to be counted and which are to be ignored (masked out). This is done individually for each input or output channel. The error counters count fields with un-masked errors (for interlaced formats) or frames with un-masked errors (for progressive formats), not individual errors, of which there can be many in a single field The maximum error rate generated in a single channel is thus equal to the field rate or frame rate. Setting the error rate alarm limit in Multicon below the lowest field/frame rate (20 errors/s, for instance) will thus guarantee that any *permanent* error condition will trigger the alarm.

If the input to a channel should disappear altogether, an internal counter with a frequency slightly above 60 Hz will take over. This guarantees that the error rate from the LOCK error and VS error bits are always at least as high as the error rate generated by the other types of errors.

The YCS, CCRC and YCRC error bits have no meaning in SD. These are not available for inputs 7 and 8, which are SD only.

On the de-mux side there are only VS and LOCK error bits available. These error indicators are actually transported from the mux side; to save power there are no actual error detectors on the de-mux side, except on the 10G fiber transport stream. If errors are

indicated on the 10G stream, chances are that one or more of the outputs have also been affected. The error bits for the fiber transport stream are limited to LOCK error and FF-CRC error. This FF-CRC bit is not the same as FF-CRC for normal SDI video, but rather a mapping of several internal checksums into one error bit. This error counter behaves as the others in the sense that the error count per second is limited to slightly more than 60.

> Note that when an input is missing, only the LOCK error bit is set, not the other error bits. Generally it is therefore a good idea to count the LOCK error bit, as the other error bits will indicate that everything is OK when the input signal has indeed been lost. Individual reclocker alarms also exist, and while a single observation of loss of lock is enough to trigger these alarms, the lock status is only sampled when Multicon asks the card for its current status. The update frequency will thus depend on how many other cards are in the system, and glitches in lock status will not necessarily be reported to Multicon to trigger an alarm there.

3.1.4 Expected video format

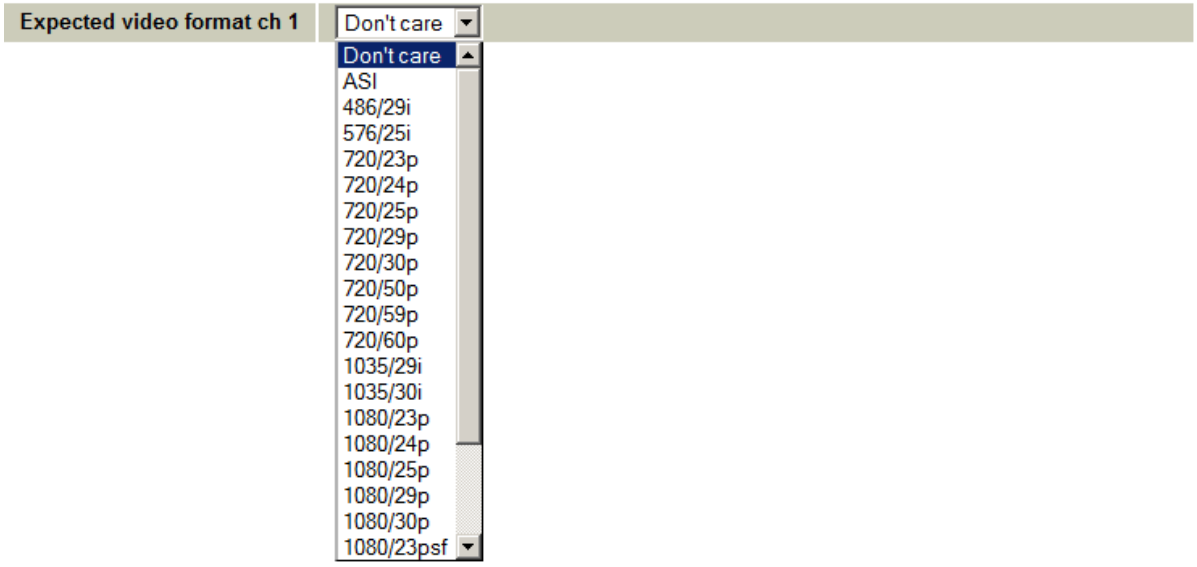


Figure 5: Selection of expected video format

In transport products like these it is not always enough to know that video is present and error-free. It can be equally important to know that the video format is correct. The operator can select an *Expected video format* for each channel. An input or output signal that doesn't match its expected video format will be indicated as a VS error in Signal integrity (see ch. 3.1.3). In addition to the formats shown in the figure above, 1080/24psf, 1080/25i, 1080/29i and 1080/30i are available in the menu if scrolled down. For channel 7 and 8 (that are limited to 270 Mb/s) the selection of expected video format is reduced to ASI, 486/29i and 576/25i, in addition to the *Don't care* setting.

> Note that in order to trigger a Signal integrity alarm, the VS error bit must be set to Counted and the error rate set below the video frame rate. Note also that missing video will not trigger the VS error bit. The operator should instead rely on the LOCK error bit or the reclocker alarms to detect loss of lock. See note at the end of ch. 3.1.3.

3.2 In manual mode (DIP switch control)

At present there is nothing that can be controlled from the DIP switches, except that the lower switch is used to put the module in the DIP switch controlled mode itself. This will then only serve as a protection mechanism, in the sense that commands from Multicon will be ignored in manual mode. The module will still answer status requests from Multicon, and Multicon can thus still be used to monitor the module and trigger alarms in the event of errors.

Note that the switch that selects operating mode is only read at start-up. I.e. to go from DIP switch control to Multicon control (or vice versa) the switch position must be changed *and* the module restarted. The inward postion (i.e. to right in the drawing below) is manual mode and the outward position is Multicon controlled mode.

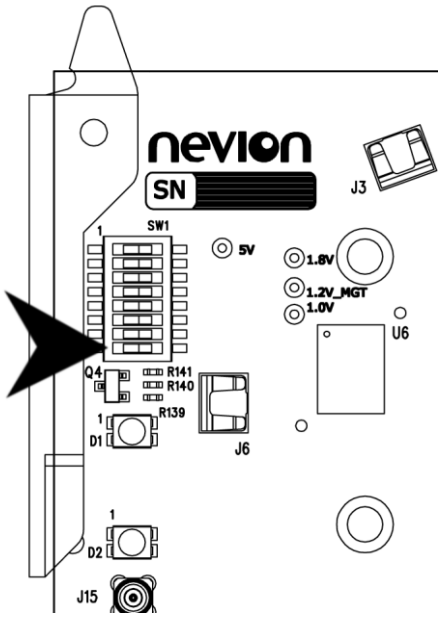


Figure 6: Location of the manual/Multicon control switch

3.3 With GPIO pins (mux side only)

There is only one GPIO pin that is an input to the module. This has no function on the de-mux, but on the mux it provides another way to shut down the laser. This is intended as a safety feature when work is being done on the rear of a live Flashlink rack.

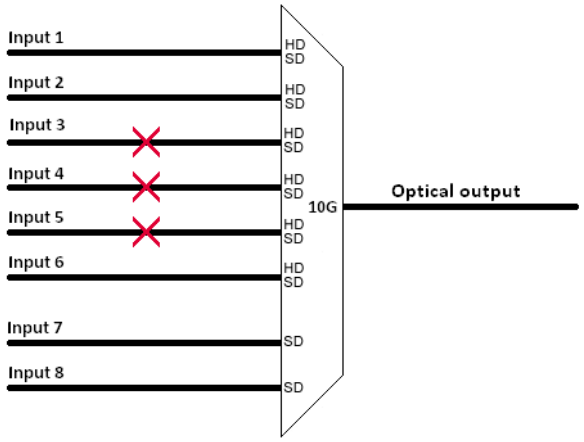
When the GPIO pin is pulled to ground, the laser is disabled. See Table 1 in chapter 2 for GPIO pin-out.

4 Monitoring

4.1 In Multicon

The Multicon information page shows the status of the modules. In the illustration below the mux and de-mux are used together and are transporting three 720/59p channels and two 576/25i channels, while three channels are not utilized.

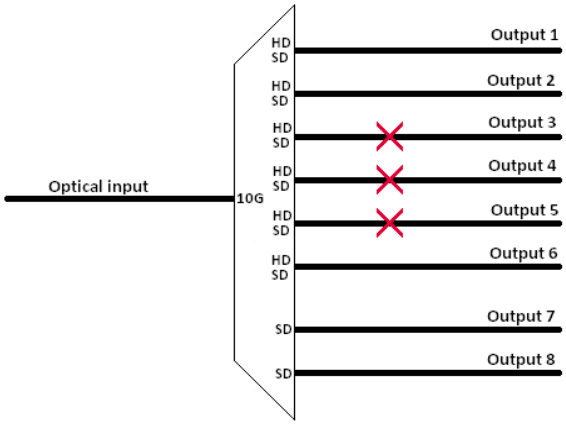
HD/SD mux with 10G uplink



Laser	On	1530nm	1.4dBm	WDM
SFP temperature	54.1 C			
FPGA core temperature	49.7 C			
Input integrity 1 (HD/SD)	720/59p	Error counter: 7595	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 2 (HD/SD)	720/59p	Error counter: 7364	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 3 (HD/SD)	Loss of signal	Error counter: 20238	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 4 (HD/SD)	Loss of signal	Error counter: 20312	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 5 (HD/SD)	Loss of signal	Error counter: 24045	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 6 (HD/SD)	720/59p	Error counter: 85	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS YCS CCRC YCRC		SAV	EAV
Input integrity 7 (SD)	576/25i	Error counter: 3275	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS		SAV	EAV
Input integrity 8 (SD)	576/25i	Error counter: 5610	Reset	
	VS	FF-CRC	AP-CRC	LOCK
	CCS		SAV	EAV
Voltage (5.0V, unregulated)	5.06 V			
Voltage (3.3V)	3.35 V			
Voltage (1.8V)	1.84 V			
Voltage (1.2V)	1.21 V			
Voltage (1.0V)	0.98 V			

Figure 7: The mux info page in Multicon

HD/SD demux with 10G downlink



Optical input	Signal detected	-20.0 dBm
SFP temperature	42.2 C	
FPGA core temperature	42.3 C	
10G input integrity	Error counter: 17242 Reset FF-CRC LOCK	
Output integrity 1 (HD/SD)	720/59p Error counter: 17241 Reset VS LOCK	
Output integrity 2 (HD/SD)	720/59p Error counter: 17241 Reset VS LOCK	
Output integrity 3 (HD/SD)	Loss of signal Error counter: 22889 Reset VS LOCK	
Output integrity 4 (HD/SD)	Loss of signal Error counter: 21870 Reset VS LOCK	
Output integrity 5 (HD/SD)	Loss of signal Error counter: 18176 Reset VS LOCK	
Output integrity 6 (HD/SD)	720/59p Error counter: 17241 Reset VS LOCK	
Output integrity 7 (SD)	576/25i Error counter: 17241 Reset VS LOCK	
Output integrity 8 (SD)	576/25i Error counter: 17241 Reset VS LOCK	
Voltage (5.0V, unregulated)	4.94 V	
Voltage (3.3V)	3.29 V	
Voltage (1.8V)	1.79 V	
Voltage (1.2V)	1.18 V	
Voltage (1.0V)	0.98 V	

Figure 8: The de-mux info page in Multicon

Hopefully much of this will be self-explanatory. The temperature of the SFP and the FPGA and the voltage of several power rails on each board are monitored, and can trigger alarms if they fall outside their respective limits. These limits can be seen in the alarm section of the Configuration page. The alarms themselves are a feature of Multicon, please refer to the Multicon user manual.

In the graphical representation of the mux and de-mux boards there are three red crosses representing the mux inputs (or de-mux outputs) that have no signal. This information is also available in the tables below the respective pictures, where channels 3-5 indicate *Loss of signal.* The channels that do have a recognizable video format will indicate the video format present. In the event that un unknown format is present, this will be indicated as *Unknown* but still be transported if possible.

Each channel also has its own error bit indicators. The boxes that have a red background color indicate an error that is currently detected and counted. A green background will indicate that the particular error is set to be counted, but that the error is currently not detected. Errors that are not to be counted (i.e. set to *Ignore*) will be presented as the error bit name on a gray background color (no example shown here), regardless if the error is currently detected or not. Error types that are not supported for that particular channel will be shown as blank boxes with gray backgrounds. Most web browser will expand the boxes that contain text at the expense of these blank ones, as the examples above show.

4.2 On front mounted LEDs

	Red LED	Orange LED	Green LED	No light
Card status	FPGA not loaded, or at least one voltage outside legal levels	---	Module is OK	Module has no power
Mux: Laser **De-mux: Pin**	Laser missing or failed Input missing or signal below -28 dBm	Laser present but turned off Input signal below -25 dBm	Laser present and turned on Input signal stronger than -25 dBm	Module has no power
Inputs 1-4	At least one of the channels 1-4 that are not set to *Don't care* is missing lock	At least one of the channels 1-4 that are not set to *Don't care* is locked to the wrong video format	Channels 1-4 are all either set to *Don't care* or are present and have the right video format	Module has no power
Inputs 5-8	At least one of the channels 5-8 that are not set to *Don't care* is missing lock	At least one of the channels 5-8 that are not set to *Don't care* is locked to the wrong video format	Channels 5-8 are all either set to *Don't care* or are present and have the right video format	Module has no power

Table 2: LED states and what they mean

The LEDs on the board are not labeled in silk screen. Users familiar with the Flashlink range will know that the upper LED (closest to the red handle) is the status LED. The order of the rest of the LEDs corresponds to the order in the table above.

> Note that the configuration of the Expected video format will influence the way the LEDs behave. The "Don't care" condition mentioned in the table above refers to the "Expected video format" settings, and only those channels assigned a specific video format will affect the LEDs. Conversely, setting all channels to "Don't care" will result in LED 3 and LED 4 always being green, even if all video signals are missing.

4.2.1 Exceptions/special conditions for the LEDS

The *locate* command will make all four LEDs blink on and off synchronously to quickly identify the module in a larger installation. The condition of the card is not otherwise affected by the command, only the appearance of the LEDs will change. The LEDs return to their normal states and functions after the special locate condition has timed out.

4.3 On GPIO pins

There are three GPIO status lines, see Table 1: Connector functions on page 5. One is a general card status alarm; the connection to ground is open when the card has either detected a critical fault or is powered off, the connection to ground is closed when the module is in normal operation. This GPIO pin effectively follows the status LED described in Table 2 in the previous chapter.

Then there are two alarms that reflect LEDs 3 and 4 described in Table 2; a green LED gives a closed connection to the ground pin, while a red or orange LED gives an open connection to the ground pin.

5 Technical data

5.1 Engineering drawings

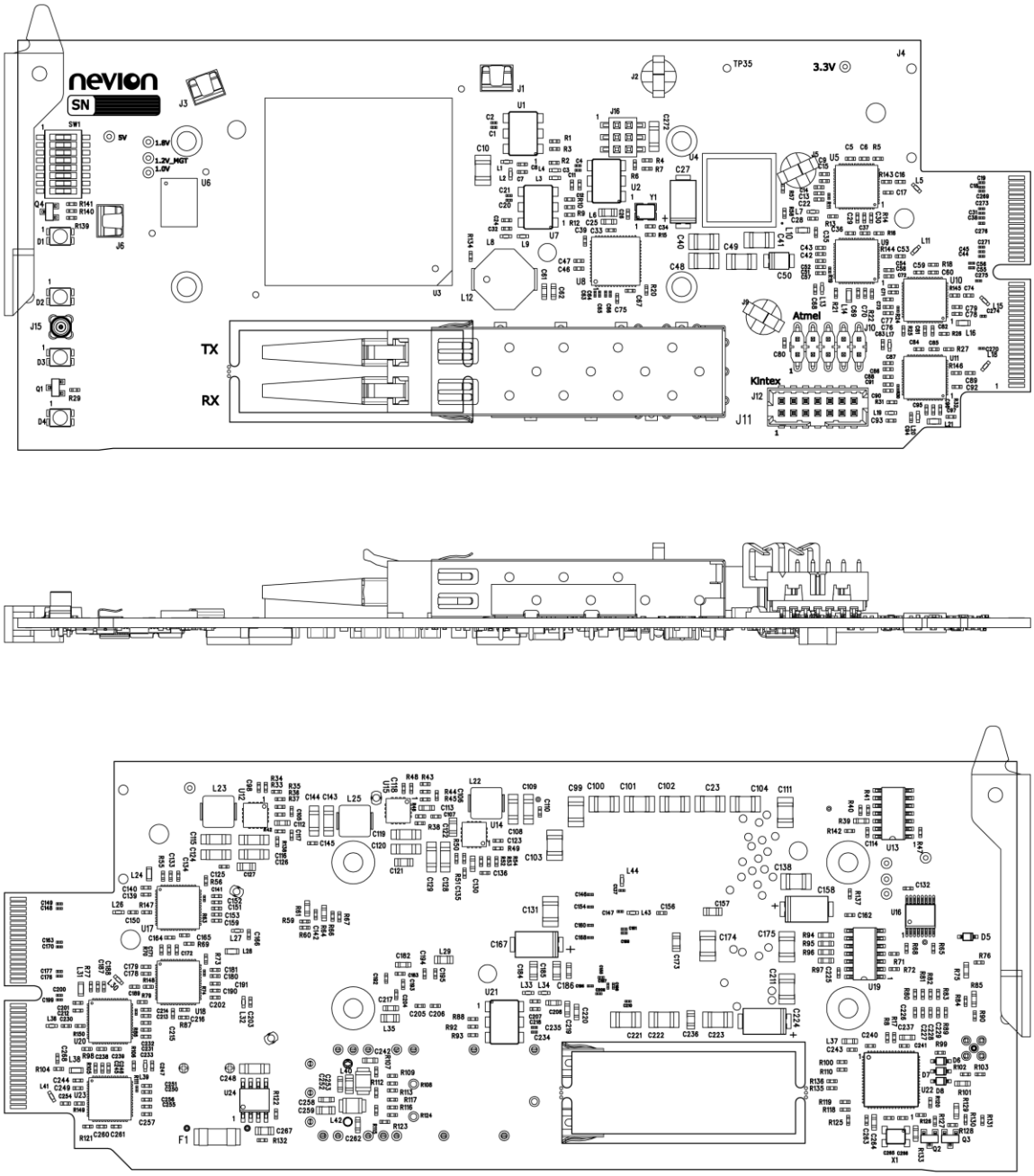


Figure 9: Front, bottom and rear views of the mux and de-mux hardware. See ch. 2 for backplane drawings.

5.2 Specifications

Optical 10G input/output

See relevant SFP+ datasheet

Electrical SDI inputs

Number of inputs	8
Connectors	75 Ohm BNC
Equalization	Automatic; >275 m @270 Mbps w/Belden 8281, with BER < 10E-12 >100 m @1485 Mbps[1] w/Belden 1694A, with BER < 10E-12
Input Return loss	>15 dB, 5 MHz -1.5 GHz
Jitter tolerance	SD limit: 10 Hz-1 kHz: >1 UI 10 kHz – 5 MHz: >0.2 UI HD limit[2]: 10 Hz-100 kHz: >1 UI 100 kHz–10 MHz: >0.2 UII

Electrical SDI outputs

Number of outputs	8
Connectors	75 Ohm BNC
Output Return loss	>15 dB, 5 MHz -1.5 GHz
Output signal level	800 mV +/- 10%
Output signal rise / fall time	SD limit: [0.4 ns – 1.5 ns]; <0.5 ns rise/fall var.
20% - 80%	HD limit: <270 ps, <100 ps rise/fall var.
Amplitude overshoot	<10%
Output timing jitter	SD: <0.2 UI HD: <1 UI
Output alignment jitter	SD: <0.15 UI HD: <0.15 UI

Supported standards

SD, 270 Mbps	SMPTE 259M, SMPTE 272M-AC
HD, 1485 Mbps	SMPTE 292M, SMPTE 274M, SMPTE 291M, SMPTE 296M, SMPTE 299M
ASI	EN50083-9

Power consumption when used as multiplexer (+5 VDC)

Maximum power, at 50°C	12.2 W

Power consumption when used as de-multiplexer (+5 VDC)

Maximum power, at 50°C	7.8 W

Subtract 0.5 W from the power figures above if the boards are used without the piggy-back fan modules. This requires the use of a rack with built-in fans for cooling!

[1] Applies to channels 1-6 only
[2] Applies to channels 1-6 only

General environmental requirements for Nevion equipment

1. The equipment will meet the guaranteed performance specification under the following environmental conditions:
   - Operating room temperature range: 0°C to 45°C
   - Operating relative humidity range: <90% (non-condensing)

2. The equipment will operate without damage under the following environmental conditions:
   - Temperature range: -10°C to 55°C
   - Relative humidity range: <95% (non-condensing)

Product Warranty

The warranty terms and conditions for the product(s) covered by this manual follow the General Sales Conditions by Nevion, which are available on the company web site:

www.nevion.com

Appendix A Materials declaration and recycling information

A.1 Materials declaration

For product sold into China after 1st March 2007, we comply with the “Administrative Measure on the Control of Pollution by Electronic Information Products”. In the first stage of this legislation, content of six hazardous materials has to be declared. The table below shows the required information.

組成名稱 Part Name	Toxic or hazardous substances and elements					
	鉛 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr(VI))	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
HD-TD-10GMX-6 HD-TD-10GDX-6	O	O	O	O	O	O
O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006. X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.						

This is indicated by the product marking:

A.2 Recycling information

Nevion provides assistance to customers and recyclers through our web site http://www.nevion.com/. Please contact Nevion’s Customer Support for assistance with recycling if this site does not show the information you require.

Where it is not possible to return the product to Nevion or its agents for recycling, the following general information may be of assistance:

- Before attempting disassembly, ensure the product is completely disconnected from power and signal connections.
- All major parts are marked or labeled to show their material content.
- Depending on the date of manufacture, this product may contain lead in solder.
- Some circuit boards may contain battery-backed memory devices.